FOREST Management BULLETIN

TIPS ON HARDWOOD FOREST MANAGEMENT

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INTRODUCTION

This Bulletin attempts to cover highlights of the information presented at the Symposium on Southeastern Hardwoods held in Dothan, Alabama on September 15-16, 1971. Authors' names appear in italics following their contributions. Their names and addresses are listed on page 5 in case the reader wants to contact them for more details on subject matter or the source of material presented.

MANAGEMENT OF NATURAL STANDS

Except in very few instances, the 100 million acres of hardwood forest lands in the South are very poorly managed. This is chiefly due to past and present practices of "diameter limit" cutting, that is, harvesting all trees in a stand that exceed a given measurement in diameter.

This is poor management for one simple reason: hardwoods naturally occur in even-aged groups. Therefore, it follows that the smaller diameter trees are the slow growers. In other words, the landowner who uses the diameter limit method of cutting to manage his forest keeps the culls and sells the best producers. He is continually downgrading his stand and increasing his rotation length! — — *Frank W. Shropshire*

A growth and yield study of naturally occurring, mixed stands of southern hardwoods indicates that this condition is widespread throughout the South. In this study, data were obtained from 650 plots, scattered throughout the region all of which were representative or productive and fully stocked stands to be managed in the future. The best sites (black river bottom of the Coastal Plain) yielded only one cord per acre per year. The poorest sites (upland ridges and slopes of the Piedmont and mountains) yielded 0.4 cord per acre per year, with the yield of all site types averaging 0.75 cord per acre per year. — — *R. C. Kellison*

Single-tree selection is not recommended as a harvest method. Removing the oldest or largest trees only, either as single scattered trees or in small groups, opens a stand gradually and therefore tends to favor development of the usually less desirable tolerant species.

Diameter-Limit Cutting. Harvesting all trees in a stand that exceed a given diameter is a poor hardwood management practice. The larger trees are the fastest growers.

In general, only two harvest methods are recommended for natural hardwood stands:

Individual tree thinning cuts. A good rule of thumb is always to thin from below. This way, the remaining stem crowns will close rapidly and reduce epicormic branching. Such cuts should be made as soon after a stand reaches merchantable pulpwood size as possible. Thin early and often so the stand is not allowed to slow down in growth (once a stand begins to taper off, it never fully regains its original rate of productivity when thinned). Spacing depends on age of the stand, but crowns must have adequate room to expand for the next 5 to 10 years, depending upon length of cutting cycle. The single most important factor to keep in mind is condition of the crown, because a tree with an undeveloped, narrow crown will not be able to respond and enlarge its crown to compete with the neighboring stems. With the individual tree thinning method, each successive cut yields a volume that is higher in grade and therefore more valuable — from the initial pole thinning to the final sawlog harvest.

Group selection. With this method, the mature timber is removed in small groups varying in size from one acre to 40 or 50 acres. However, some stands that have grown on abandoned agricultural fields or following a severe fire may contain several thousand acres. This method should not be used until the

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stand is ready for regeneration, and remember: when a group is selected for cutting all stems must be removed. Otherwise adequate desirable regeneration cannot be achieved. — — *Frank W. Shropshire*

It is not enough to harvest the merchantable timber from stands that are to be naturally regenerated; stems too small for merchantability and cull trees must also be removed to allow complete ground exposure. When handled in this manner the same desirable species will occur in the regenerated stand as were present in the harvested stand, although not in the same proportion. — — *R. C. Kellison*

SOIL MANAGEMENT

Soil management is the key to successful hardwood establishment and management because soil properties are probably the most important factors that govern hardwood forest productivity.

Broadly speaking, four soil variables regulate forest productivity: (1) physical condition, (2) available water during the growing season, (3) aeration, and (4) nutrient availability. Soil and site factors that influence these variables are: history, past use, present cover, compaction, presence of natural or artificial pans, soil structure and texture, physiographic position, local topography, water table, growing-season wetness, flooding, mottling, soil color, presence of topsoil and organic matter, geologic source of soil, pH, and soil chemical composition.

Rough estimates of soil suitability for the major hardwood species can be made by considering these factors and their interaction. If the forester has access to soil surveys, or can obtain the advice of a soil scientist, these estimates can be made on the basis of the soil series as shown in the table on page 6.

Soil management involves the manipulation of the four soil variables that regulate forest productivity. The forest or soil manager must not only know how to alter these factors, if needed for the benefit of tree growth, but he must also realize how other land management systems affect these factors. For example, the soil profiles from old-fields in certain areas usually contain artificial hardpans (plowpans). These pans normally develop on medium textured soils after many years of cultivation. The soil manager can usually improve the physical condition of the soil, and thus tree growth, by proper mechanical treatment such as deep plowing which fractures the hardpan.

Periodic cultivation in young hardwood plantations can increase the supply of available water to trees by controlling competing vegetation. Irrigation during dry periods may be another possibility of increasing soil moisture. On wet sites, however, soil moisture relations as well as aeration can be improved by drainage. The last of the soil factors, nutrient availability, can be improved by fertilization and liming. Leguminous cover crops offer another possibility of increasing soil fertility.

Site Preparation Important. For acceptable return on investment, site preparation is a vital need in artificial regeneration of hardwoods.

It is important that the forest manager be able to recognize which of the four factors is the most influential on tree growth. It's often difficult to increase growth by simply altering one factor. For example, some infertile sites will not respond to fertilizers until some other growth limiting factor such as aeration is improved. —— *W. M. Broadfoot, B. G. Blackmon, and J. B. Baker.*

PLANNING FOR NATURAL REGENERATION

If foresters wait until after final harvesting to plan for reproduction, it is generally too late. The chances of increasing the proportion of a particular species in the new stand depend upon that species' reproductive characteristics and the character of the old stand.

The Survey

The first step in planning for regeneration is to survey understory plants. Ideally, there should be two surveys, one from 1 to 2 years before and one just before the stand is to be cut and regenerated. Factors to evaluate in these surveys are:

Understory species and seedbed conditions;
Overstory density and composition;
Frequency and duration of flooding; and
Excessive grazing damage by deer or cattle.

Tips on Regeneration

1. The overstory in heavily cutover stands can be cut at one time and probably should be to avoid repeated logging damage to established reproduction.
2. Research has shown that if American hornbeam and eastern hophornbeam are not removed they will remain dominant and eventually will result in mortality of the better species. When that occurs, complete species conversion through planting becomes necessary.
3. Size of the reproduction area matters little provided there is adequate stocking.

4. Where vines are numerous, approximately 10 thousand seedlings per acre are required. Where vines are scarce, 2 or 3 thousand seedlings per acre may suffice.
5. Bare mineral soil seedbed is highly desirable for establishment of yellow-poplar, American sycamore, and other species that reproduce primarily from seed.
6. The minimum size of opening needed for development of desirable hardwood reproduction is ½ acre. —— *Robert L. Johnson*

ARTIFICIAL REGENERATION

Artificial regeneration of hardwoods is expensive, with costs reaching $100 per acre through the first year under some conditions. Therefore, a land manager should not attempt artificial hardwood regeneration unless he intends to follow *each* step necessary for good results, as borne out by research to date. For maximum yields, shortest rotations, and acceptable return on investment, hardwood plantations require:

1. Correct species and site combinations
2. Intensive site preparation
3. Large, vigorous, well-planted seedlings
4. Clean disk cultivation during the first and, sometimes, the second year
5. Protection from fire
6. Protection from livestock and deer herds (where they are abundant), especially during the first two years. —— *John A. Nugent*

TREE IMPROVEMENT

Hardwood tree selection and breeding can play a significant role in improving quality and growth of future crops. However, do not expect selection and breeding to make up for poor nursery management, poor seedling handling, poor quality stock and poor planting methods! Avoid seed or seedlings from sources with growing seasons appreciably different (either longer or shorter) than that of the planting site. Although it is possible that seedlings could be moved a short distance to the north of their natural range to achieve a slight increase in growth rate, this must be done with caution. In fact, it should be accompanied by carefully established field trials.

Most studies of seedling grade in hardwoods indicate that root collar diameter is a good indicator of subsequent growth. By using careful nursery techniques for growing progeny test seedlings, it should be possible to apply some selection for larger root collar diameter and thereby probably achieve some genetic gains as evidenced by early growth rate. Too, recent data indicate that for 3-year-old sycamore and 6-year-old sweetgum, heritabilities of height growth range between 20 and 30 percent.

Individual parent trees show important differences in straightness and branching characteristics, which in turn affect self-pruning. These characteristics are inherited strongly. Tolerance to pests also is becoming an important objective of hardwood breeding programs.

Substantial improvements in tree quality and increased volumes per acre can be accomplished by using properly grown seedlings of local seed source, which are properly planted and managed. This degree of tree improvement is immediately available and is not dependent upon a seed orchard program requiring 10 to 12 years to produce substantial quantities of genetically improved seed.

Seed should be collected only from well-formed individuals growing in stands of well-formed trees. This is an absolute minimum requirement for the artificial regeneration of hardwoods. Beyond this, refined programs of selection and breeding of hardwoods can produce substantial improvements in form and growth rate when combined with intensive cultural measures. —— *Charles D. Webb*

INSECT AND DISEASE CONTROL

Insects and diseases seldom kill southern hardwood trees in managed forests, but they cause major economic losses by lowering wood quality and quantity and by reducing tree growth and regenerative potential. Mill studies reported in 1964 showed that insect-caused defects in lumber from southern oaks resulted in value losses from degrade averaging about $20 per thousand board feet. For the 3 billion board feet of oak harvested annually in the South, this amounts to some 60 million dollars. Wood decay and associated defects in natural bottomland forests cause more volume losses than all other hardwood diseases combined. It is difficult to assign exact dollar values, but the wood volumes culled and left in the forest or discarded at the sawmill due to rot represent a complete loss of potential value that runs into many millions annually.

White Oak Borer. Trunk borers are the most destructive group of insects in hardwood stands. Shown here are white oak borer galleries in overcup oak saplings.

Economically, the trunk borers are the most important destructive group of insects in hardwoods. Larvae of the carpenterworm and longhorn beetles attack the trees throughout their growth, and construct large galleries in the wood. Bark injuries at entrance holes become ingrown bark pockets in the wood and micro-organisms stain and decay the wood along and adjacent to the galleries. This damage may be greatly augmented by carpenter ants which occupy vacated borer tunnels and hollow out large nest cavities. Many smaller borers such as the Columbian timber beetle, greasespot borer and oak timber worm and the Nitidulid sap beetles add to the damage in many hardwood species.

Research is aimed at protecting the trees from trunk damage during their growth. Identification of sex-attractant pheromones and development of chemical sterilization techniques will provide biologically acceptable methods for reducing adult borer populations. Considerable progress has been made at the U. S. Forest Service's hardwood laboratory at Stoneville, Mississippi toward these goals and success is expected. Meanwhile, forest sanitation practices can remove weak, cull trees which harbor insects and diseases. Such practices should effectively reduce the level of attack in the vigorous trees.

Fire prevention is important for both disease and insect loss reductions. Trunk rot and canker fungi can destroy much of the valuable butt log following fire injuries. Other rot enters through broken tops and branch stubs. Research has learned the identity and effect of most of the rot and canker fungi; so present studies are focusing on their biology, mode of attack and establishment in trees, and their dispersal. These may lead to methods for reducing decay damage in the growing tree.

Defoliation by insects and fungi causes serious growth limitations and loss of seed from destruction of tree flowers. For example, the forest tent caterpillar defoliation of coastal gum forests limits growth to about one-fourth the potential for the year and prevents seed production. Foliar diseases in cottonwoods greatly reduce growth and weaken trees to the extent that they may be attacked by canker fungi and insects. Ultra-low-volume spraying of gum forests and cottonwood plantations with certain selected insecticides has demonstrated effective control of insects without damage to associated wildlife. This is a great step forward in protecting our hardwoods.

— L. P. Abrahamson and F. I. McCracken

WILDLIFE HABITAT MANAGEMENT

Bottomland hardwoods of the Coastal Plain represent one of the most productive wildlife habitats on the North American continent. For example:

- The carrying capacity of deer on many bottomland areas is about three times that of longleaf pine-slash pine types. Too, bottomland hardwoods produce bigger deer than upland forest types.
- Some of the highest turkey populations in the country occur in the bottomland hardwoods along the Mississippi River in Mississippi and Arkansas, some populations exceeding one bird per 15 acres.
- Bottomland harvests of squirrels have ranged as high as 22 times that of harvests on longleaf-loblolly stands.
- Bottomland hardwoods also abound in non-game species. For example, of the 383 species on the checklist of Louisiana birds, only 49 are classed as game. Of the total, 225 are found in bottomlands as resident, wintering or transient birds.

In managing hardwood forests selective cutting is acceptable game management, but it should not be done too conservatively if deer are to be supported. A mature hardwood stand with closed crowns may be essentially free of understory vegetation that comprises good deer browse and cover.

Establishment of contiguous cottonwood plantations over an extensive area eliminates squirrels. However, if the plantations are established on relatively small areas throughout a bottomland hardwood stand that is managed by selective cutting, they are definitely beneficial to some species of wildlife. For the first two or three years, such plantations provide feeding, loafing and resting sites for turkey. They support tremendous rabbit populations for the first few years. Both bobwhite quail and rabbit populations could be managed in cottonwood plantations if supplemental food plots, 1/8 to 1/4-acre in size, were scattered throughout the stand, and cover consisting of two or three good brush piles per acre were provided.

Free Hunting is Expensive

Many bottomland hardwood owners may be practicing poor management by permitting free hunting on their lands, because control of the game harvest is practically impossible. By leasing hunting rights, the owner maintains some control over the game harvest and realizes an added monetary return as well. Hunters are paying from 50 cents to $5 per acre yearly for such privileges.

The private club is a good approach to fee hunting. It offers the best line of communication between landowner and sportsman, and through the club the landowner can exert any degree of control he may wish on persons using the game resource. Some tips to landowners who lease to hunting clubs:

1. Whenever possible, permit club members and guests to use access roads with an understanding the roads will be repaired by the club when weather and water conditions permit.
2. Encourage the use of elevated deer stands. They can be built without nails and no harm to trees. This will assure a greater deer harvest, which is usually the primary goal of the landowner. Too little deer harvest can do more damage to hardwood regeneration in six months than 10 years of hunting lease payments would cover.

3. Allow the club to plant scattered plots in oats or some other winter crop for deer and turkey. These often facilitate the harvest of deer.

— — *Leslie L. Glasgow and Robert E. Noble*

INCREASING TIMBER SALE RETURNS

How can hardwood landowners increase dollar returns from the sale of timber from their lands? This question was put to land and mill managers in four southern states — small land owners, large land owners with and without processing plants, managers of processing plants without forest land, and consulting foresters. Here are a few of the tips they gave:

- Use of a "dependent" contractor is one means of achieving good utilization when the owner has sufficient land and volume available to keep a contractor steadily occupied. Among other things, this system enables the owner to take advantage of a temporary market situation to sell high value, specific products.

- A system of partial payment for timber by units enhances competition by keeping initial payments low and thereby attracting smaller contractors. In one sale, the number of bidders increased from one to four and the purchase price increased from $38 to $48 per thousand board feet.

- If adjacent small landowners can combine their sales, more bidders may be attracted to the sale and each owner stands to gain a higher price for his timber.

- Advice from industry on management? Favor species with a future, such as black walnut, sweet pecan, ash, cottonwood, high quality red oaks, yellow poplar and sweetgum ——*George D. Screpetis*

MANAGEMENT ALTERNATIVES

Hardwood forest landowners face many management alternatives — managing for wood and wildlife, for example, as opposed to wood production alone. Or conducting a recreation business on certain tracts. The question is, how to evaluate the alternatives in terms of economic returns.

First, obtain an accurate inventory of the standing timber. Second, clearly define the additional options that appear economically feasible. No market? Infeasible. Third, specify foreseeable cost and return for each alternative. Finally, apply Clark Row's 1970 version of the Discount and Rate of Return Program or any similar computer program that will provide present net worths or benefit-cost ratios for each option. Copy of Row's program (Version Five-1108 Edition) available from Southern Forest Experiment Station, T-10210 Federal Building, 701 Loyola Avenue, New Orleans, Louisiana 70113.

In a simulation of financial returns from a hardwood bottomland site, with costs and returns ranging from low to high, the only condition that favored combining recreation with wood over a straight wood production plan was where anticipated stumpage prices fell below $40 per thousand board feet. With higher stumpage prices, the income generated by recreation did not offset financial losses due to decreased timber yields, regardless of whether average or optimistic net returns from recreation were chosen. Stumpage prices lower than $40 suggested that if a market existed for recreation it should be included in the production scheme. Each case differs, of course, but the evaluation technique does offer hardwood forest landowners a practical, effective means of judging for themselves and "looking before leaping" into a business enterprise.

——*George Dutrow and William E. Balmer*

INFORMATION SOURCES

(1) Frank W. Shropshire, Hardwood Specialist, Southeastern Area, State & Private Forestry, U. S. Forest Service, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, Mississippi 38776.

(2) R. C. Kellison, Associate Director, Cooperative Programs, North Carolina State University, Raleigh, North Carolina.

(3) W. M. Broadfoot, B. G. Blackmon and J. B. Baker, Principal Soil Scientist and Soil Scientists, Southern Forest Experiment Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, Mississippi 38776.

(4) Robert L. Johnson, Principal Silviculturist, Southern Forest Experiment Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, Mississippi 38776.

(5) John A. Nugent, Staff Forester, International Paper Company, Natchez, Mississippi 39120.

(6) Charles D. Webb, Project Manager-Genetics, Champion Woodlands Division, Champion International, Athens, Georgia.

(7) L. P. Abrahamson and F. I. McCracken, Entomologist and Pathologist, respectively, Southern Forest Experiment Station, Southern Hardwoods Laboratory, P.O. Box 227, Stoneville, Mississippi 38776.

(8) Leslie L. Glasgow and Robert E. Noble, Associate Director and Assistant Professor, respectively, School of Forestry and Wildlife Management, Louisiana State University, Baton Rouge, Louisiana 70803.

(9) George D. Screpetis, Log and Tree Quality Specialist, Southeastern Area, State and Private Forestry, U. S. Forest Service, 2500 Shreveport Highway, Pineville, Louisiana 71360.

(10) George Dutrow, Research Economist, Southern Forest Experiment Station, T-10210 Federal Building, 701 Loyola Avenue, New Orleans, Louisiana 70113.

(11) William E. Balmer, Resource Specialist, Southeastern Area, State and Private Forestry, U. S. Forest Service, 1720 Peachtree Road, N.W., Atlanta, Georgia 30309.

SOIL SUITABILITY TABLE

Species	Best Suited	Least Suited	Limiting Factors
Cottonwood	Adler, Catalpa, Collins, Commerce, Coushatta, Falaya, Kaufman, Latanier, Marietta, Morganfield	Atwood, Calloway, Dulac, Henry, Kalmia, Lax, Leaf, Stough, Mashulaville, Tippo	Low moisture, Low nutrients, Poor aeration
American sycamore	Adler, Collins, Commerce, Dubbs, Latanier, Marietta, Morganfield, Robinsonville, Ochlockonee, Vicksburg	Atwood, Henry, Izagora, Lax, Leaf, Prentiss, Mashulaville, Stough, Tippo	Low fertility, Poor aeration
Yellow-poplar	Chewacla, Collins, Falaya, Iuka, Marietta, Ochlockonee, Vicksburg	Alligator, Buxin, Catalpa, Perry, Jackport, Tuscumbia	Excessive wetness, Poor aeration, High pH.
Sweetgum	Adler, Arkabutla, Collins, Chewacla, Commerce, Dundee, Marietta, Morganfield, Urbo	Bibb, Buxin, Henry, Leaf, Mashulaville, Perry, Stough, Tippo, Tuscumbia	Low moisture Poor aeration
Green ash	Adler, Arkabutla, Catalpa, Collins, Commerce, Falaya, Marietta, Mhoon, Waverly, Wehadkee	Atwood, Bude, Cahaba, Crevasse, Henry, Kalmia, Lax, Mashulaville, Prentiss, Stough	Low moisture
Water tupelo	Alligator, Bibb, Johnston, Una, Waverly, Wehadkee	Atwood, Crevasse, Henry, Lax, Stough, Mashulaville	Low moisture Alkaline soil
Nuttall oak	Arkabutla, Bowdre, Chewacla, Falaya, Houlka, Iuka, Mantachie, Newellton, Urbo	Atwood, Catalpa, Crevasse, Falkner, Kalmia, Lexington, Stough, Mashulaville, Tippo, Trinity	High pH, Low moisture
Shumard oak	Bruno, Bosket, Collins, Dubbs, Memphis, Vicksburg	Catalpa, Henry, Johnston, Perry, Roebuck, Tuscumbia	High pH, Poor aeration
Cherrybark oak	Arkabutla, Chewacla, Collins, Dundee, Falaya, Houlka, Iuka, Ochlockonee, Urbo, Vicksburg	Baldwin, Catalpa, Commerce, Crevasse, Johnston, Mhoon, Moreland, Portland, Trinity, Tuscumbia	Low moisture, Poor aeration, High pH.
Willow oak	Amagon, Collins, Arkabutla, Dundee, Houlka, Urbo	Atwood, Catalpa, Crevasse, Lax, Johnston, Stough	High pH, Low moisture Poor aeration
Swamp chestnut oak	Arkabutla, Chewacla, Collins, Forestdale, Urbo	Atwood, Catapla, Crevasse, Lax, Mashulaville	High pH, Low moisture
Water oak	Amagon, Bowdre, Chewacla, Collins, Falaya, Urbo	Atwood, Catalpa, Crevasse, Stough, Tippo	Low moisture, High pH.
White oak	Chewacla, Collins, Dundee, Gallion, Iuka, Memphis, Vicksburg	Buxin, Catalpa, Iberia, Mhoon, Johnston, Tuscumbia	High pH, Excessive moisture, Poor aeration